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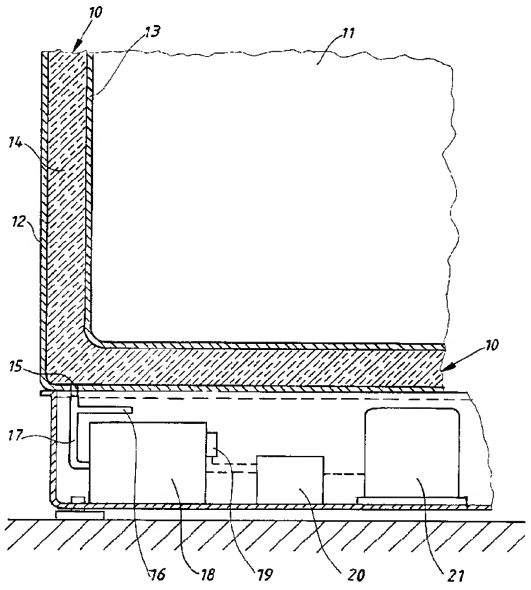
(71) Applicant : **ELECTROLUX RESEARCH & INNOVATION AB**
Luxbacken 1
S-105 45 Stockholm (SE)

(72) Inventor : **Roseen, Rutger Arvid**
Vrakvägen 9
S-181 49 Lidingö (SV)

(74) Representative : **Erixon, Bo et al**
c/o AB ELECTROLUX Corporate Patents & Trademarks
S-105 45 Stockholm (SE)

(54) Refrigerator or freezer.

(57) This invention relates to an electric refrigerator or freezer. The cabinet comprises one or several hermetically sealed heat insulated spaces (14) being wall or door panels in the cabinet said space or spaces via an evacuation conduit (17) communicating with a vacuum creating device (18). The vacuum creating device is a permanently installed unit in the cabinet which is arranged to be activated when or after that the cabinet has been installed at the user of the cabinet and after a long period of running creates a suitable underatmospheric pressure in the space or spaces (13).



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This invention relates to an electric refrigerator or freezer.

It is previously known to use different types of insulation material for the abovementioned cabinets in order to achieve as good insulation caracteristics as possible for the walls and doors of the cabinet. Usually foamed plastic materials having open as well as closed cell structures are used between the inner and outer metal plate and/or plastic shells in the walls but it has also been suggested to use different types of insulating powder materials.

In order to reduce the power consumption of the cabinets it has also been suggested to use so called vacuum panels in the walls and the doors. See for instance EP 188806. When manufacturing these panels a powder or celluar material is surrounded by a diffusion tight layer which is placed between the outer and the inner shell of the wall after which the space containing the powder is evacuated and sealed. By means of this method is it however, in industrial processes, difficult to reach sufficiently low pressures to maximize the insulation caracteristics since the evacuation process is very time consuming and is not well suited for mass fabrication. It should in this connection be mentioned that the time which is needed for evacuation to a pressure of abt. 1 mbar during the conditions mentioned above is within the range of 15 hours whereas the production time for a refrigerator is abt. 20 min. The evacuation time can neither be improved by using a pump with a high capacity since the evacuation time is determined by the narrow communication passages which are present in the powder or cellular material. There of course also is a risk that, during the life time of a refrigerator which is 15 - 20 years, there will be a leakage at the diffusion tight layer which means that the contribution which the vacuum gives to the insulation caracteristics disappear.

It is also previosly known, see US 4448041, to use vacuum insulated wall elements for large mobile refrigerating chambers in which the wall elements are connected to a vacuum pump. These vacuum pumps are however of conventional type and hence relatively power demanding and expensive and their use can with regard to costs and energy consumption only be motivated at the type of large equipment which is described in the abovementioned publication.

Further FR 2628179 describes hermetically sealed wall elements which in a way which is not described in detail are connected to some kind of vacuum source. The pressure which is created is 50 - 100 mbar and is rather high and within such an interval that it can not in any crusial way contribute to increase the heat insulating caracteristics.

The purpose of this invention is to achieve an arrangement by means of which it is possible to create a high-quality vacuum insulation for refrigerators and freezers but where the arrangement does not have the disadvantages which have been mentioned above with respect to the vacuum panels described. The invention is based on the idea that the cabinet when it is manufactured is equipped with a small,cheap and energy saving vacuum pump having a limited capacity and communicating with hermetically sealed spaces in the walls and the door of the cabinet these spaces being filled with heat insulating material also serving as stiffening elements in order to achieve mechanical stability. The energy consumption of the vacuum pump is thus far less than the saving of energy which is a result of the evacuation. When the cabinet is started up by the user the pump is activated and the pump then gradually creates a very low pressure during a long period of use which means from a week up to some months thereby gradually increasing the efficency of the insulation. This is achieved by means of a device which has the caracteristics mentioned in the claims.

One embodiment of the invention will now be described in detail with reference to the accompanying drawing in which the figure schematically shows a section through a refrigerator or a freezer according to the invention.

In the figure several wall parts 10 are shown surrounding a cold chamber 11 the wall parts comprising an outer and an inner shell 12 and 13 resp. which are connected to each other and which therebetween form a hermetically sealed space 14 which is filled with heat insulating material. Preferably all of the walls of the cabinet form one single hermetically sealed space whereas the door or the doors form seperate spaces. The spaces can also be created in other ways for instance by surrounding the insulating fill material with a plastic layer which is placed in the shell. The fill material preferably comprises closed cells which are produced by foaming polyol/isocyanate with a gas having such caracteristics that it can diffuse through the cell structure with a velocity which is at least five times the velocity of the air gases. A suitable drive gas is carbon dioxide. The space 13 as well as the corresponding spaces in the doors of the cabinet is via evacuating channels communicating with an evacuation conduit 17 which is connected to a vacuum pump 18.

The vacuum pump which has a low capacity is driven by an electric motor having a power consumption which is less than 5 W preferably less than 2 W. The evacuation is, according to what is said above, continued very far which means that a pressure which is less than 0,1 mbar is upheld in the evacuation conduit 17 and in the insulating material this level being reached after at least one week of continious running of the vacuum pump 18. This means that the heat transmission coefficient is reduced with 50 % compared to traditional refrigerators which despite the running of the vacuum pump results in a considerable saving of energy. The pressure in the evacuation conduit 17 is directly or indirectly sensed by means of a

sensor 19 which is connected to an electric control system 20 deactivating the pump 18 when a specific underatmospheric pressure has been reached in the evacuation conduit. The control means 20 can also be used for activating or deactivating the compressor 21 in the cabinet from the thermostat.

It should be observed that it is possible within the frame of the invention to keep the vacuum pump running continiously as well as it is possible to disconnect the pump after a first period with a relatively long running time and when a sufficient underatmospheric pressure has been reached and to again connect it when the compressor is activated or to activate the pump with respect to the frequency of the connection of the compressor. The connection of the vacuum pump can also be controlled by measuring the time difference for a temperature gradient penetrating the walls of the cabinet. It is also possible to connect the vacuum pump to the compressor so that it can serve as a driving source for the pump.

Claims

1. Electric refrigerator or freezer, **caracterized in** that it comprises one or several hermetically sealed heat insulated spaces (14) being wall or door panels in the cabinet said space or spaces via an evacuation conduit (17) communicating with a vacuum creating device (18) the vacuum creating device being a permanently installed unit in the cabinet which is arranged to be activated when or after that the cabinet has been installed at the user of the cabinet and after a long period of running creates a suitable underatmospheric pressure in the space or spaces (14).

2. Refrigerator or freezer according to claim 1, **caracterized in** that the vacuum creating device (18) is a low power consumption pump the drive motor of the pump having a power consumption which is less than 5 W preferably less than 2 W.

3. Refrigerator or freezer according to claim 1. **caracterized in** that the vacuum creating device has such caracteristics that a pressure less than 0,1 mbar is achieved in the insulated space or spaces (14) after more than 1 weeks continious running of the vacuum creating device (18).

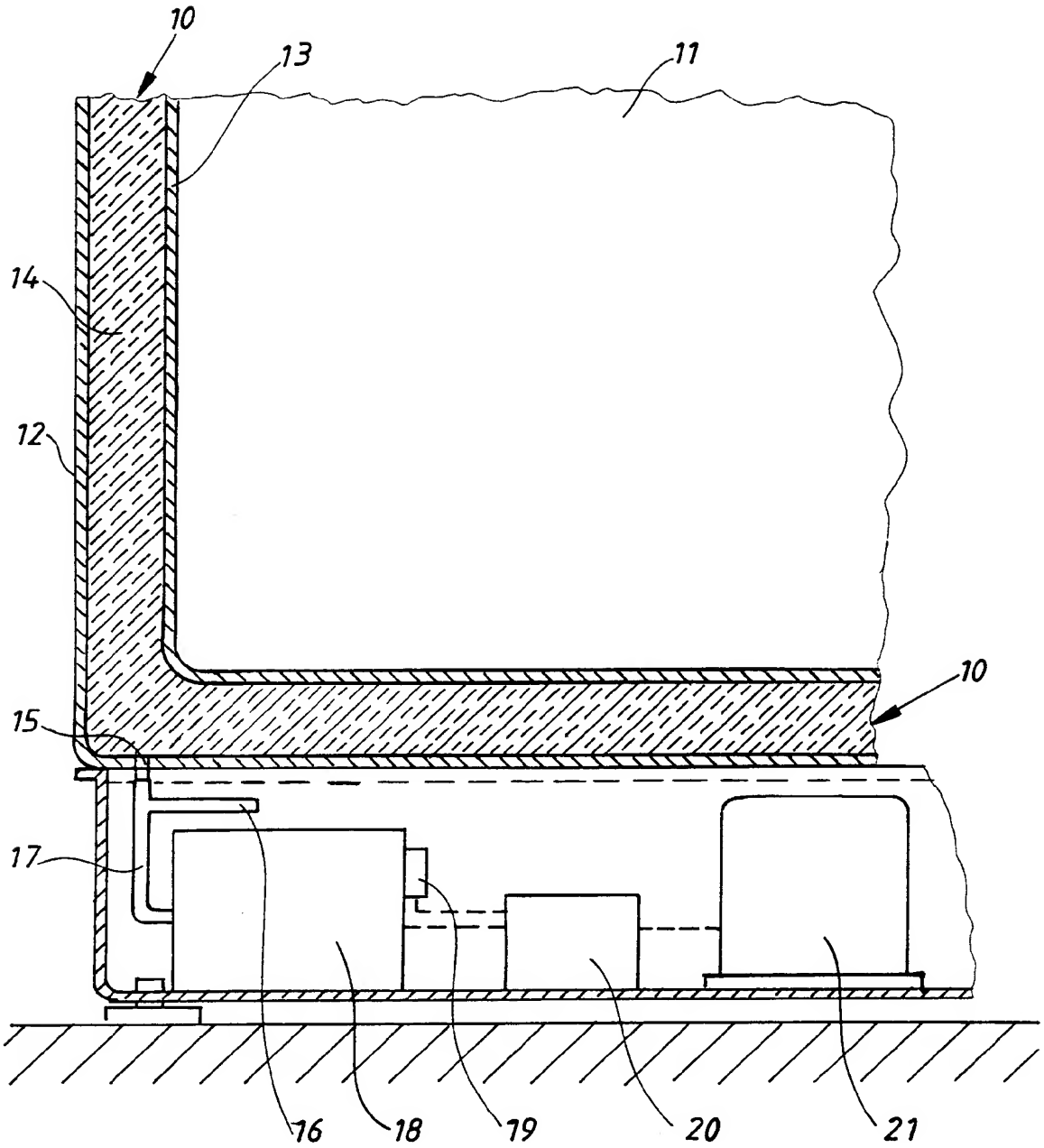
4. Refrigerator or freezer according to any of the preceding claims, **caracterized in** that the vacuum creating device (18) directly or indirectly communicates with a pressure sensor which deactivates or activates the device when a predetermined pressure has been reached in said space or spaces (14).

5. Refrigerator or freezer according to any of the preceding claims, **caracterized in** that it comprises at least one compressor (21) the vacuum creating device (18) being activated at the same time as the compressor is activated or that it is activated as a function of the connection frequency of the compressor.

6. Refrigerator or freezer according to any of claims 1 - 4, **caracterized in** that the connection of the vacuum pump is controlled by measuring the time difference for a temperature gradient to penetrate the wall of the cabinet.

7. Refrigerator or freezer according to claim 1, **caracterized in** that the walls of the cabinet form one single hermetically sealed space whereas the door or doors form seperate spaces.

8. Refrigerator or freezer according to claim 5, **caracterized in** that the compressor is used as a drive source for the vacuum pump.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EUROPEAN SEARCH REPORT

Application Number
EP 93 85 0167

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X A	US-A-1 898 977 (COMSTOCK) * page 3, line 19 - page 10, line 71; figures 1-11 *	1 7	F25D23/06
D,A	FR-A-2 628 179 (HDG ENERGIE) * page 5, line 8 - page 8, line 32; figures 1-4 *	1,4	
A	US-A-2 550 040 (CLAR) * column 8, line 16 - line 43; figure 14 *	1,4	
A	US-A-1 550 961 (HAWKINS) * the whole document *	1,5,7,8	
A	US-A-1 518 668 (MITCHELL)		
A	GB-A-715 174 (GENERAL ELECTRIC)		
A	GB-A-865 391 (ROLLS-ROYCE)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 January 1994	Boets, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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